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The botany of the California Islands

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There are eight islands off the coast of Southern California. The northern group, visible from Santa Barbara, are Anacapa, Santa Cruz, Santa Rosa, and San Miguel, enumerating them from east to west. The southern group, much more widely scattered, consists of Santa Catalina, San Clemente, Santa Barbara and San Nicolas. It is confusing to find the northern islands often referred to as the Santa Barbara islands, whereas Santa Barbara Island is the smallest of the southern group. These islands, believed to have been separated from the mainland in Pleistocene times, are of extraordinary interest because they have upon them so many endemic animals and plants. The endemic animals include fifteen mammals, fifteen birds, two lizards, two salamanders, sixteen land molluscs, and an undetermined number of insects. The plants include over eighty species and races.

Although the islands were discovered by the expedition led by Captain Juan Rodriguez Cabrillo in 1542, knowledge of their plants came very slowly. Nearly 90 years ago Nuttall described a few from the collections of Dr. Wm. Gambel, the ornithologist, who visited California at the beginning of the forties. These included the remarkable endemic shrub, *Crossosoma californicum* Nuttall, the only genus of the family Crossosomataceae. A second species, *C. Bigelovii* Watson, has since been found on the mainland, in the desert area of the southwest. After a very long interval, the botany of San Clemente was partly made known through a visit in 1885 of J. C. Nevin and W. S. Lyon (Madrono, Vol. 2, 1931, p. 25), who discovered some very interesting endemics. It was Lyon who sent to Asa Gray the endemic and very distinct genus of trees, *Lyonothamnus*, found by him on Catalina Island. Not long after, E. L. Greene visited Santa Cruz and San Miguel; on San Miguel he was in time (1886) to see growing the tree-mallow, *Lavatera*, which has now entirely disappeared from the island. In more

recent years, Ralph Hoffmann, Director of the Santa Barbara Museum, made very extensive collections on all the northern islands. His herbarium, beautifully mounted and carefully named (with the assistance of various specialists) is in the Santa Barbara Museum of Natural History.

Hoffmann published a list of numerous additions to the island floras, and would have dealt with the whole subject in a comprehensive manner, but for his lamentable death on San Miguel Island on July 21, 1932. He was climbing a cliff in the effort to obtain specimens of a *Dudleya* (or *Echeveria*) which he thought might prove new. A small pick which he used in climbing broke, and this apparently caused him to fall, his death being instantaneous. Hoffmann was an excellent ornithologist as well as botanist, a man whose loss we can never cease to lament.

The southern islands have been visited by many botanists, especially of course Santa Catalina which is a famous tourist resort, and is easily reached. C. F. Millspaugh and L. W. Nuttall have published a Flora of Santa Catalina Island (1923), which is very comprehensive, including not only the flowering plants and ferns, but the mosses (28 species), the Hepaticae (8 species), the lichens (167 species and varieties), the fungi (203 species) and the Mycetozoa (8 species). Twenty nine species of fungi are described as new, but it is very likely that none is a true endemic. Several occur on cultivated or introduced plants. Including varieties (races), the recorded flowering plants and ferns of the eight islands collectively appears to number about 750. It may perhaps be surmised that there are actually about 900 distinct forms.* Hoffmann's island herbarium (from the northern islands only) numbers 620. Of the approximately or nearly 90 endemics, about one third are found on both the northern and southern islands, one third on the northern group only, and one third on the southern. But it must be added that there are eleven island endemics which also live far to the south, on Guadalupe Island, which is out on the Pacific 135 miles S.W. from Point San Antonio, Lower California. One of the island plants, *Pinus remorata*, is also found on Cedros Island, near the coast of Lower California. It is also reported as occurring in the Pleistocene of

* I can add one to the recorded list; the grass *Distichlis dentata* Rydberg (det. by Mrs. Chase), which I obtained on San Miguel.

Carpinteria, near Santa Barbara, but it is not certain that it grew there. Chaney and Mason have described a Pleistocene flora of nine species, found on Santa Cruz. All the species are living, but only one (*Pinus remorata*) still exists on any of the islands. The flora is said to most resemble that about Fort Bragg, 440 miles N.N.W. It includes large trunks of *Pseudotsuga taxifolia*, wood and cones of *Cupressus Goveniana*, seeds of *Garrya elliptica* etc. Remains of mammoths (*Elephas*), found on Santa Cruz, Santa Rosa and San Miguel are perhaps contemporaneous with this flora. At all events, with the sole exception of the pine, it disappeared, to be replaced by a quite different and more xerophilous flora. When or how the latter arrived remains a matter for conjecture. The geologists postulate a large area of land, called Catalinia, existing during part of the Tertiary time, and it may be that such distinct endemics as the *Crossosoma* and *Lyonothamnus* have continuously occupied this land, or what there was of it above water, since Mid-Tertiary time or earlier. Most of the endemics, however, are quite closely related to species of the mainland, and may be presumed to have evolved during or since the Pleistocene. Some of them seem very well adapted to their surroundings, and flourish exceedingly. I visited San Miguel with a group of Senior Boy Scouts, and noticed, as Greene had fifty-one years before, how the grey-green bladder pod, *Astragalus miguelensis* Greene, overran the island. It has an advantage (which of course did not exist when it first evolved) in not being eaten to any extent by the sheep. Mr. Robert Brooks tells me that it is poisonous to them, a sort of loco-weed. He also states that the excessively abundant ice-plant, *Mesembryanthemum crystallinum*, acts as a purgative on the sheep, and is avoided, though at a pinch it can serve as a source of enough water to maintain life. This *Mesembryanthemum* is also African, and is generally supposed to have been introduced from Africa, but Greene argues strongly that it is indigenous. There are strand plants, such as *Convolvulus soldanella* (which Hoffmann collected on Santa Cruz) which are widely distributed over the world, probably through the agency of birds.

There are certain species, as *Erysimum insulare* Greene (with yellow flowers and spreading pods), and *Opuntia littoralis* Engelm. (with yellow spines) which are extremely characteristic of the islands but have been removed from the list of

endemics, because they occur in certain regions on the mainland. It seems not impossible that they were originally true endemics, and somehow got carried across the water. The Indians might have used the prickly-pear fruits for food and so transported them. They might even have found nutriment in the abundant yellow seeds of the *Erysimum*; the seeds of *Salvia columbariae*, according to Millspaugh and Nuttall, were ground into meal, for porridge and cakes.

The clearest cases of true island endemics, that is, forms which have developed their special character upon the islands, are found among the mammals. Baird in 1857, described the small fox *Urocyon littoralis* from San Miguel Island. We now know special races of this animal, each with distinctive characters, from Santa Catalina, San Clemente, San Nicolas, Santa Cruz and Santa Rosa. The smaller Santa Barbara and Anacapa appear to be without foxes. The remarkable tendency of mammals to form insular races is shown by the recent discovery of a special kind of mole (*Scapanus latimanus insularis* Palmer) on Angel Island in San Francisco Bay. The foxes suggest that mere isolation, regardless of the special environment, has brought about the differentiation; but as a matter of fact the islands do present some very diverse conditions. Thus it can be well understood that the white-footed mice from the mountainous, rocky, forested Santa Cruz should be darker than those from the sand-dunes of San Miguel.

I have tried to find evidence of cases among the plants to parallel those of the mammals and birds. One of the best seems to be in the Malvaceae, with *Malvastrum catalinense* Eastwood on Santa Catalina, *M. clementinum* Munz and Johnston on San Clemente, and *M. nesioticum* Robinson on Santa Cruz. But what about that other more interesting member of the family, the Malva Rosa or Tree Mallow, *Lavatera assurgentiflora* Kellogg? Millspaugh and Nuttall, in Their Flora of Catalina, state that the type locality is Anacapa Island (where Hoffmann collected it on Sept. 22, 1930) and that the only other locality is Bird Rock, not a quarter of a mile from Fisherman's Cove, Catalina. They add that Greene described a number of supposed species, all based on plants known to have been transplanted from Anacapa or Bird Rock. This last statement is not correct, for Greene, in his very interesting account of his visit to San Miguel (Pittonia, Vol. 1, 1887) states that he found

there 30 small trees of the *Lavatera*, and in another place a few bushes, and proceeds to describe how the plant differs from that in cultivation. Many years later, finding also differences in the fruit, he described the San Miguel race as *Saviniona dendroidea*. It is now wholly extinct, but as the matter stands, it presumably represents an insular subspecies, *Lavatera assurgentiflora dendroidea*. With regard to the other four names offered by Greene, the case is not so clear. *Saviniona clementina*, from San Clemente, was based on a single tree, *S. reticulata* from Catalina also on one plant. Although Greene makes a point of the forms of *Saviniona* (which was founded for a species of the Canary Islands) being all insular, he actually describes *S. suspensa* from San Diego, and supposes the original plant of Kellogg to have come from the mainland of California, somewhere near San Francisco. In favor of the view that the forms on the several islands may be, or may have been, distinct, is the fact that Watson described three endemic species from the Mexican islands southward.

Another puzzling case is that of the Tree-poppies, *Dendromecon*, beautiful shrubs with yellow flowers. Munz accepts the insular representative, *D. Harfordii* Kellogg, as a valid species, and adds the remark: "variable and needing study." Greene (Pittonia Vol. 5) recognized five supposed species, the original *D. Harfordii* from Santa Rosa, *D. flexilis* from Santa Cruz, *D. densifolia* from Santa Rosa, *D. rhamnoides* from San Clemente, and *D. arborea* from Santa Catalina. These are all separated by stated characters, and presented in a table. But evidently Greene's material was insufficient, and it will be necessary to study the variation of the plants where they grow. Miss Alice Eastwood, in a letter just received, refers to "the great variability that insular floras always present." Millspaugh and Nuttall have repeatedly referred to the same phenomena in their account of Santa Catalina. Variability is often ascribed to crossing, which should be reduced to a minimum in the restricted floras of islands. Thus *Opuntia littoralis*, in its pure stands on the islands, appear very uniform; but on the mainland it crosses with other species, and confusion results. *Astragalus miguelensis* and *Erysimum insulare*, as I saw them on San Miguel, seemed to me very constant in their characters; so also *Malacothrix implicata* Eastwood, common along the cliffs by the sea, except that the rays were sometimes entirely

without the purplish tint. Yet in certain genera, for reasons which are obscure, there appears to arise a condition of mutability on islands, and perhaps we may say in general, at the periphery of the range. Such mutability is evidently advantageous, in that it provides the material for extensions into new territory, some of the variations being advantageous in the new environment. If the insular variability is an expression of such a tendency, we may suppose that it occurs principally during a period following the introduction of the species, and that after a time one of the forms proves best fitted to survive, and prevails to the exclusion of the rest. Thus such a species as *Astragalus miguelensis* would be a climax type, now stable; while certain of the poppies, *Dendromecon* and *Eschscholtzia*, are still in the variable stage, so that the number of "valid" forms is uncertain. It is evident that the thoughtful biologist, anxious to understand the processes of nature, will wish to study all these variable plants, and will not contemptuously dismiss them as "bad species."

Phacelia scabrella is one of the plants described by Greene from San Miguel, but it is ignored by Munz, who regards it as identical with *P. distans* Bentham. I found it dried up at the time of my visit but on one plant were two of the beautiful light blue flowers, and bees of the genus *Anthidium* were flying over it. Brand recognized *P. scabrella* as a variety of *P. distans*, occurring in the Coast Range northward, but southward only on the islands. It would thus fall in with a long list of plants cited by Munz as having a similar distribution.

The islands have suffered from the influence of man especially in two ways; they have been greatly overgrazed, and very numerous weeds and other plants have been introduced. The introduction of various forms of animal life is likely to also prove injurious. Thus, as Mr. E. Z. Rett explains to me, the foxes on Santa Cruz, about 1927, got scab from the sheep, and were almost exterminated, though they are now increasing again. This trouble has not occurred on San Miguel. Mr. D. B. Rogers informs me that Santa Barbara Island is now full of rabbits (introduced), and these must seriously affect the native flora. In a good many cases, the accidentally introduced plants are represented by only a few specimens, and do not appear to spread. Thus on San Miguel, 51 years ago, Greene said of *Marrubium vulgare*, "a single plant but that in flower and

fruit." I found it growing near the ranch house this year, but it is still a casual alien. The island lists have been greatly swollen by the inclusion of numerous aliens, so that in statistical treatment the proportion of endemics appears to be much less than it actually is, in relation to the original flora. Many of these aliens can be recognized at once, being of European or other exotic derivation, but there is no ready way to recognize California mainland species which may have been carried over during the past century. To this class would probably belong, for instance *Datura meteloides*, represented in the Hoffmann herbarium by two specimens, one from Santa Cruz and one from Santa Rosa, and also known from Santa Catalina. Something should be said about the absence of plants which might have been expected to occur. There are no gymnosperms whatever on the southern group of islands. Among the grasses, the Paniceae are all absent, and I find no records of *Bouteloua*, *Muhlenbergia*, *Sporobolus*, etc. Of the genera of grasses included by Munz in his S. California Manual, 26 are present on one or more of the islands, while 39 are absent. Of the Liliaceae, seven are present, eight absent, the latter including *Yucca*. *Myrica*, *Juglans*, *Alnus*, *Celtis*, *Castanopsis*, and *Lithocarpus* are all absent. Only two genera of orchids are present. In the Ranunculaceae, three genera are present, seven absent, the latter including *Paeonia*, which from its mode of occurrence on the mainland might have been expected. Of the genera of Compositae (including *Cichoriaceae*) recognized by Munz, 61 are present, 66 absent. These and similar facts may be taken to indicate that the islands were not united with the mainland very recently.

The relationships of the Californian Island flora with that of the Mexican Islands southward is a matter of much interest. Was there once continuous land all the way to Guadalupe Island? The snails would suggest yes, the absence of land mammals on Guadalupe, no. But there are eleven of our island endemics which also occur on Guadalupe. These belong to the genera *Quercus*, *Eschscholtzia*, *Crossosoma*, *Lotus*, *Convolvulus*, *Oenothera*, *Gilia*, *Phacelia*, *Galvesia*, *Mimulus*, and *Hazardia*. Greene long ago gave lists of the plants he found on Cedros Island and the San Benito Islands, near the coast of Lower California. Of the 91 Cedros species about a fourth are also on the Californian Islands, of the 26 San Benito species, a third. These islands are approximately in Lat. 28°.